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Assessment of Livelihood Coping Challenges and Viable Solutions available to Small-scale Farmers Aimed at Enhancing their Resilience to Rainfall Variability in Bunyala Sub-county, Kenya.

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Abstract

Farmers in Bunyala sub-county depend on rain fed agriculture and over the years frequent floods and droughts, crop failures and water shortages have become common. Research has shown that small-scale farmers in the developing countries are more vulnerable to rainfall variability due to their reliance on rainfed agriculture and poor adaptive capacity. However, most studies so far have concentrated on climate-driven coping capacity in flood prone areas and arid and semi-arid areas and have not considered the challenges experienced by small scale farmers in the wake of these coping strategies and opportunities and innovations that can be explored to enhance the coping capacity to rainfall variability. The objective of this study was to establish the coping challenges and identify viable solutions through opportunities and innovations to enhance small scale farmers' resilience to rainfall variability. Data was collected through use of questionnaire, interviews, focus group discussion and field observation. Bunyala Sub-County has about 15,245 households in six locations. Proportionate stratified sampling was used to select the required number of respondents. The stratification was based on the populations of six locations. A total of 384 households were randomly selected and sampled from the selected locations together with 11 key informants. Qualitative and quantitative data analysis techniques were used while the results were presented in tables, figures and charts. Findings of the study indicate several challenges stand in their way like lack of technical support and financial constraints. The study recommends that adaptive practices must be promoted while simultaneously strengthening long-term, sustainable institutional responses to help households adapt to rainfall variations. The farmers should be sensitized on the need to engage in sustainable adaptation strategies such as planting drought tolerant crops and use of agricultural technology. Small-scale farmers' should focus on information gathering, enhance social networks to improve on their financial capability. Local communities be empowered through trainings/skills programs (new technology for farming) to improve small-scale agricultural productivity. Women, as important contributors to food production and income generation, should be empowered to access resources such as finances and land, and trained to develop decision-making skills.

Key Words: *Livelihoods, Resilience, Smallscale Farmers, Rainfall variability, Opportunities, Innovations*

Introduction

As developing countries are highly dependent on agriculture, there are growing concerns that this change in weather variability will further threaten the food security of already vulnerable rural households in developing nations and pose a serious challenge to development efforts. In light of this unending threat, it is imperative that a deeper understanding of the impact of weather extremes on the rural poor and the effectiveness of current coping mechanisms be captured. Although changes in rainfall and weather patterns are being felt worldwide, Barrios *et al.*, (2008) found that agricultural production in Sub-Saharan Africa is particularly sensitive to weather variability as the availability of water differs widely throughout the geographically diverse continent.

Coping with chronically changes in yields of food crops is important for the survival of farming households in rural areas where agro-climatic conditions are challenging. A study by Adger et al. (2007) adaptation to climate change is an adjustment made to human, ecological or physical system in response to a perception on vulnerability. Coping reactions can be categorized according to level of ownership of the coping measure or strategy. Individual level or autonomous copings are usually considered to be those that take place in reaction to climatic stimuli (after manifestation of initial impact) that is as a matter of course and without the direct intervention of any public agency (Smit and Pilifosova, 2001). Autonomous copings are widely taken to be initiatives by private actors rather than by public usually triggered by market or welfare changes brought about by actual or anticipated climate change (Leary, 1999). Policy-driven or planned adaptation and coping is often taken as being the result of a deliberate policy decision on the part of a public agency, based on the level of awareness that conditions are about to change or have changed and that action is required to reduce losses or benefit from opportunities (Osman-Elasha, 2010; Pittock and Jones, 2000).

In agriculture many poor farmers in many regions of the world have often developed farming systems adapted to the local environmental conditions, enabling them to generate sustained yields to meet their daily subsistence needs despite marginal land endowments, rainfall variability and low use of external inputs (Wilken, 1987; Denevan, 1995).

According to a study by Canadian farmers by Bryant *et al.,* (2000) shows that small scale farmers' responses vary when confronted with the same climate conditions, even within the same geographical area, given various agricultural systems and market systems in which farmers operate. Supporting the idea that personal behavior and conditions influence coping strategies, several studies have noted that farming experience, socioeconomic position, and access to resources, financial resources, and extension services increase the chances of uptake of coping and adaptation measures to rainfall variability (Maddison, 2006; Nhemachena and Hassan, 2007). Moreover, the nature of farmers' response to rainfall variability also depends on the socioeconomic position of the family— poor rural farmers are likely to take measures to ensure their survival while richer farmers make decisions to maximize profits (Ziervogel *et al.,* 2006).

Recent studies on agricultural technology adoption also offer some important insights into the factors contributing to farmers' decision-making process. Although agricultural adaptation does involves more than adopting a new technology, introducing new technology certainly plays a greater role in coping at the farm-level. This study reveals that a number of individual, household/family and farm characteristics, and institutional framework (policy, social, market,) factors influence farmers' decisions. Higher levels of education contribute to access to information on improved technologies and the adoption of enhanced agricultural innovations and technologies (Norris and Batie, 1987; Igoden et al., 1990; Lin, 1991). Studies indicate that larger families may be put the household in a position to accomplish a variety of agricultural tasks given fewer household labor shortages (Croppenstedt *et al.,* 2003; Hassan and Nhemachena, 2007). Studies also tend to agree that households with higher income and greater assets will be more likely to adopt new farming methods, given an enhanced access to information and financial resources (Franzel, 1999; Knowler and Bradshaw, 2007).

Head of the household is considered to influence the uptake of new technologies (Asfaw and Admassie, 2004; Tenge *et al.,* 2004; Nhemachena and Hassan, 2007). However, depending on the context, studies differ on whether female headed households or male headed households are more likely to adopt new technologies. Farming experience and age also appear to be predominantly significant determinants of technology adoption, although the direction of the impacts varies across studies. Studies in Kenya have shown a positive relationship between years of experience in agriculture and the adoption of improved agricultural innovations (Kebede *et al.,* 1990). Moreover, a study by Shiferaw and Holden

(1998) indicated a negative relationship between age and uptake of enhanced soil conservation practices, which suggests that older farmers may be less willing to take the risks associated with new farming practices and technologies.

A study done in Kenya by (Tittonell *et al.,* 2009) found that farmers complained that lack of finances to buy food is usually their greatest worry and threat to their household's wellbeing, but also that lack of seed and inputs is the main constraints on achieving food security. Women in Mbeere, Siaya and Nakuru stressed that the need to pay for school fees constitutes an additional drain on their scarce financial resources, especially since they need to be paid at a time when farmers also need to buy farm tools and equipment and prepare for the new farming season.

Climate-smart agriculture involves agricultural techniques – such as intercropping, mulching, integrated pest and disease management, conservation agriculture, crop rotation, agroforestry, integrated crop-livestock management, fish farming, improved water management, better climate forecasting for farmers – and innovative ways, like early warning systems (FAO, 2010; World Bank, 2011; 2012). It also involves embracing new technologies – like diversifying genetic traits of crops to help farmers edge against an uncertain climate – and creating an enabling policy environment for adaptation (World Bank, 2011). In the absence of climate-smart agriculture, areas which are marginalised may become less suited for arable farming as a result of land degradation through deforestation, soil erosion, repetitive and overgrazing (World Bank, 2012).

Climate-smart agriculture is production and location system-specific. Thus, its precise nature is determined by local factors including the climate, varieties of crops grown and livestock reared, available technologies and knowledge and skills of specific farmers (FAO, 2010). However, there is acceptance that climate-smart efforts must have at their heart small-scale farmer who is key to change across the entire agricultural system.

Altieri and Koohafkan (2008) argues that existence of genetic diversity has special significance for the maintenance and promotion of productivity of smallholder farming systems, as diversity also gives security to farmers against pests and diseases, specifically pathogens that may be promoted by climate change.

Institutions play an important role in influencing how communities and households react to the effects of climate change. A study by Argawal *et al.,* (2008) the duties of local institutions influence the impact of external interventions in shaping coping and improving the ability of the most vulnerable social network groups. This is important to the success of adaptation projects. Similarly, local institutions are important as they provide the policy framework within which local institutions such as CBOs and NGOs. The national institutions are instrumental in mobilizing capacity to intervene when extreme climate related hazards occur. Coordination between national and local level institutions is fundamental in this respect.

It is important to note one of the survival mechanisms of the rural poor, such as smallholder farmers and marginalized sections of society is their potential and capability to be organized and act as a group in order to fulfill their needs or demands on many issues. In course of normal life, situations often arise when the household head needs to meet family requirements immediately, often by taking help from others members of the society. They interact with one another as employers/employees, neighbours, kins and friends gradually build social networks of regular association through these bonds (Jana & Choudhuri, 2013).

People in rural areas traditionally rely on social networks for their survival. This survival mechanism are often related to food and nutrition and security status (Martin *et al.,* 2004) co-management of limited natural resources (Pretty, 2003).

Statement of the Problem

Kenya like many other countries in Africa is highly susceptible to rainfall variability. The economy as well as the wellbeing of its people is dependent on rain fed agriculture, therefore an adverse a change in rainfall amount and distribution may mean increased food insecurity, soil erosion and land degradation,

over flooding leading to damages in infrastructure and settlements and an outbreak of diseases like malaria (Twinomugisha, 2005). It is worth noting that Kenya in the recent years has been experiencing an increase in the frequency and intensity of extreme weather events with serious socio-economic consequences. The country has experienced seven severe droughts over the period 1991-2008, affecting over 35 million people who required immediate humanitarian assistance (CIESIN, 2005). Agriculture is arguably the most vulnerable sector to drought, with crops affected badly if the drought occurs during the growing season. Any damage to the agricultural sector leaves the country exposed to hunger, famine and increase in disease incidence.

Research has shown that small-scale farmers in the developing countries are more vulnerable to rainfall variability due to their high reliance on rainfed agriculture and poor coping capacity. However, most studies so far have concentrated on climate-driven coping capacity in flood prone areas and arid and semi-arid areas and have not considered the challenges experienced by small scale farmers in the wake of these coping strategies. Opportunities and innovations that can be explored to enhance the coping capacity to rainfall variability especially in areas with both floods and drought regimes like Bunyala sub-county need to be examined. It is against this background that this study sought to examine livelihood coping challenges and viable solutions among smallscale farmers to enhance their resilience to rainfall variability in Bunyala sub-county.

Objective of the Study

The study was guided by the following objective:

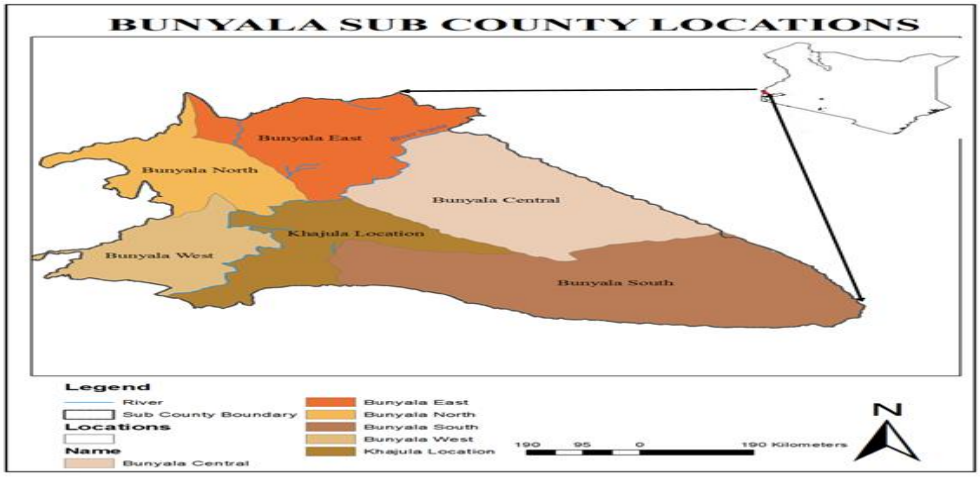
To establish the coping challenges experienced and identify viable solutions through opportunities and innovations to enhance small scale farmers' resilience to rainfall variability

Research Methods and Materials

The design of the study was descriptive survey which allowed large amounts of data to be collected over a short period of time. It provided for numeric descriptions of the population. It also enabled the researcher to describe and explain relationships between dependent and independent variables.

The broad research strategy used in this research is qualitative in nature. A qualitative methodology of inquiry is rooted in the phenomenological paradigm as opposed to the positivist school of thought (Corbetta, 2003). The phenomenological paradigm emphasizes understanding, analyzing and describing phenomena without necessarily relying on quantitative measurements and statistics (Dawson, 2007). In direct contrast to positivism, phenomenological approaches accept subjectivity as opposed to objectivity. Phenomenology also allows for interpretation of events and phenomena such as those identified in the study on livelihood coping strategies among small scale farmers to rainfall variability in Bunyala sub-county, Kenya as opposed to strict quantitative measurements.

Bunyala Sub County was selected as the study area because of its positioning since it is a region characterized by small farm holdings averaging 2.4 acres per household and is a marginalized agricultural area due to exposure to rainfall variations where both extremes are experienced that is floods and drought respectively. Bunyala Sub County is a particularly useful case for illustrating a region that has to cope to the double exposure of floods and drought. The agricultural sector in the sub county is particularly exposed to economic pressures due to its marginal farming conditions that are not conducive to large-scale production. Various coping strategies are practiced by the community to cushion themselves against adverse weather conditons. People have settled near the dykes along the river in some locations and encroachment into flood plains for agriculture, livestock keeping and fishing.



Map of Bunyala Sub-County showing the study locations

Target population

The study targeted households drawn from the six locations that comprise the sub-county. A total of 15,245 households were used to arrive at the sample size in the entire sub-county as shown in Table 3.1. The choice of households was informed by the need to investigate rainfall variability as perceived by households rather than individual farmers. The unit of analysis was the household and therefore the study targeted a total of 15,245 household.

Distribution of Households in Bunyala Sub-County

Location	Area (Km²)	No. of Households
Bunyala West	14.6	3521
Bunyala North	27.3	2710
Bunyala East	41.9	3318
Bunyala Central	47.7	2470
Khajula	20.1	1762
Bunyala South	36.8	1464
Total	**188.4**	**15,245**

Source: KNBS (2010)

The sample size for the present study was based on the margin of error approach derived from the central confidence interval for proportions (Tabachnick & Fidell, 2013). Consequently, a sample of 384 was therefore selected for the study. Both stratified and simple random sampling techniques were used to select the required 384 small scale farmers. First the sub-county was stratified in terms of the six locations. The number of farmers to be drawn from each location was proportionate to the population of households in each location relative to the entire sub-county

Stratification of Sampled Households

Location	Number of house holds	Number in sample
Bunyala West	**3521**	$\frac{3521}{15245} \times 384 = 87$
Bunyala North	**2710**	$\frac{2710}{15245} \times 384 = 68$

Bunyala East	**3318**	$\frac{3318}{15245} \times 384 = 84$
Bunyala Central	**2470**	$\frac{2470}{15245} \times 384 = 62$
Khajula	**1762**	$\frac{1762}{15245} \times 384 = 44$
Bunyala South	**1464**	$\frac{1464}{15245} \times 384 = 39$
Total	**15,245**	**384**

Simple random sampling was then used to select the respective household heads from each location. All household heads in each location were assigned random numbers. Random number generation was then used to select the required number per each location. Gender sensitivity was considered by purposively targeting female headed households.

Three instruments were used in the data collection for the study these included household survey questionnaire, focused group discussion guide, and key informants interview schedules. The choice of three data collection instruments was informed by the need to triangulate data collection considering how sensitive findings from the study could be. In addition field observations were done practically by use of photographs. Consequently, collecting data from various sources using diverse instruments was ideal for more reliable data. Reliability coefficients of the six measurement scales used in the study were revealed that with the exception of opportunities and innovations (α=.625), all the other scales achieved the recommended reliability level of 0.7. This implies that the scales in question had a high degree of internal consistency among the measurement items. Although the reliability for opportunities and innovations fell below the 0.7 limit, it was above the minimum acceptable value of 0.6 (Hair et al., 2008). For this reason this scale was retained alongside the others.

Findings and Discussion

Results of a cross tabulation of possible income earning activities against challenges revealed eight activities each cross tabulated against its constraints as shown below. Results particularly show that lack of money or credit (48.2%) is the major constraint to households starting or expanding these activities. Lack of skills and knowledge (32.8%), and lack of tools/equipment (12.9%) are the other constraints that feature prominently. Bunyala sub county boarders Lake Victoria the community are traditionally fishermen hence farming is a new concept to majority of them. The wish for some household members to build rental houses is constrained mainly by lack of market. Other household members desire to improve farm produce but face the constraint of lack of skills and knowledge (60%), lack of money or credit (24%), and inadequate land (16%). Members wishing to start business mainly face the challenge of lack of money or credit (87.2%), lack of skills and knowledge (10.7%) and to a lesser extent, lack of market (2.0%). For household members desiring to improve farming methods, the main challenges are lack of skills and knowledge (54.5%) and lack of tools and equipment (34.7%). The challenges of lack of money and lack of skills and knowledge also jeopardize farmers' ambitions for fish farming, dairy farming, pig rearing and poultry keeping. Most community members were found to have high levels of illiteracy having only completed primary level or some primary education. Such members found it difficult to adapt to diverse methods of farming and even planting dates that coincide with onset of rains. Negative attitude was also reported with the youth not keen on agriculture seeing it as an activity for old folks. Lack of technical skills and knowledge was recognized as a major challenge facing the small scale farmers. The essence is that most, of them have

no capacity to diversify activities they engage in even if they desire to.

The implication of the results from the farmer and institutional surveys with regards to constraints and challenges small scale farmers in Bunyala sub-county are experiencing is that whereas farmers wish to expand or start diverse activities to cope with rainfall variability, there are several farmer oriented and contextual constraints that they experience. Major constraints that also double up as challenges to enlargement and diversification of activities are lack of skills and knowledge, as well as lack of tools/equipment. The constraint of skills and knowledge is particularly of great concern since agricultural technology is taking root in view of the changing trends in weather patterns. Lack of skills and knowledge implies that farmers can hardly engage in any form of farming effectively.

The negative attitude towards farming being noticed among the youth is a manifestation of the high illiteracy levels among farmers. Lack of literacy is indeed a hindrance to acquisition of relevant skills and knowledge that farming and other agricultural practices require. The wildlife menace experienced reflects the human–wildlife conflicts that result from adverse weather changes. This indeed poses a great challenge to farmers who even after resorting to irrigation have to again fight off these animals.

Cross Tabulating Activities Farmers Desire for Improvement with Challenges Experienced

		challenges					
		lack of money or credit	lack of market	lack of skills and knowledge	inadequate land	inadequate manpower	lack of tools/equipment
activity wishes to undertake	build rental houses	0	5	0	0	0	0
		.0%	100.0%	.0%	.0%	.0%	.0%
	improve farm produce	6	0	15	4	0	0
		24.0%	.0%	60.0%	16.0%	.0%	.0%
	start business	130	3	16	0	0	0
		87.2%	2.0%	10.7%	.0%	.0%	.0%
	improved farming methods	8	3	66	0	2	42
		6.6%	2.5%	54.5%	.0%	1.7%	34.7%
	fish farming	7	0	6	0	0	5
		38.9%	.0%	33.3%	.0%	.0%	27.8%
	dairy farming	6	1	4	0	0	0
		54.5%	9.1%	36.4%	.0%	.0%	.0%
	pig rearing	5	2	2	0	0	0
		55.6%	22.2%	22.2%	.0%	.0%	.0%
	Poultry	13	2	10	0	0	0
		52.0%	8.0%	40.0%	.0%	.0%	.0%
Total		175	16	119	4	2	47
		48.2%	4.4%	32.8%	1.1%	.6%	12.9%

Results from the focused group discussions with farmers further identified several social cultural challenges to desired activities. As shown below lack of skills and knowledge in agriculture, lack of credit and stable income, laziness among some members particularly men who only care for their drinking habits, change of climate, political interference, and cultural affiliations

were enlightened as major constraints. Major constraints that also double up as challenges to enlargement and diversification of activities are lack of skills and knowledge, as well as lack of tools/equipment. The constraint of skills and knowledge is particularly of great concern since agricultural technology is taking root in view of the changing trends in weather patterns. Lack of skills and knowledge implies that farmers can hardly engage in any form of farming effectively.

Socio-economic and Cultural challenges experienced by farmers when coping with Rainfall Variability

Question	Constraint	Explanation
What challenges do you as farmers experience when you desire to expand or start other activities?	Lack of knowhow and resources	• Agriculture has pertinent skills and knowledge required. This we don't have • We do not know how to manage farming in diverse fields such as dairy and pig farming
	Attitude	• Lack access to electricity • Some men go out in search of local brews believing that women should be tending for the family as well as farming. • Some households perceive farming as requiring a lot of patience. • Dependency syndrome that is cultural has made some members to be negative towards farming
	Change in climate	• Traditional large herds of cattle seen as source of wealth • Traditionally the community were fishermen hence farming is something foreign
		• Unpredictable change in climate hinders desire to expand farming due to input costs involved • Lack of irrigation implies reliance on rain for expanded farming
	Political mileage	• Some politicians have hijacked projects initiated by rival groups or NGOs and make expansion climate un-suitable • In order to score political gains, politicians have perfected the culture of hand outs in times of distress instead of providing lasting solutions

Agricultural Institutions and Local NGOs views of Challenges Facing Small Scale Farmers in Bunyala Sub-County

Assessment of constraints small scale farmers experience in coping with rainfall variability was conducted in terms of challenges facing small scale farmers across agricultural institutions. Respondents were asked their opinions with regards to challenges facing local communities at present. Thematic analysis of responses made revealed six key challenges. Results in table below show that illiteracy, attitude, inadequate technical skills are individual farmer oriented challenges. Besides these farmers oriented, other challenges that are nature oriented were identified as wildlife menace, drought and pests and diseases.

Stakeholder views of challenges Farmers Experience in Coping with Rainfall Variability

Question	Challenge	Explanation
In your opinion, what is the biggest challenge facing local community at present?	Illiteracy	• Most community members have a basic level of education and cannot comprehend and adapt to diverse methods of farming
	Negative attitude	• Some youth do not value agriculture and see it as an activity for the elderly • The community has a history of being fishermen as opposed to farmers
	Lack of technical skills	• Agriculture is technical and requires skills and knowledge of its applications • Most farmers lack basic skills and have no capacity to innovate • Majority of the farmers have a belief use of fertilizer leads to soil degradation. • Farmers sell of most of the farm inputs given to them such as seeds and fertilizer to buy food
	Drought	• Persistent drought requires that irrigation as a farming system should be enhanced
	Human-wildlife conflicts	• The large number of hippos and monkeys are destroying the crops that may have survived. This requires that the KWS consider having a camp in the area
	Pests and diseases	• Pests and diseases remain a major challenge to communities. This may require that bulking sites be erected to provide clean planting materials • There is need for communal agro vets with subsidized prices

Most community members were found to have high levels of illiteracy having only completed primary level or some primary education. Such members found it difficult to adapt to diverse methods of farming and even time planting dates to onset of rains. Negative attitude was also reported with the youth not keen on agriculture seeing it as an activity for the old. Lack of technical skills and knowledge was recognized as a major challenge facing the small scale farmers. The essence is that most, of them have no capacity to diversify activities they engage in even if they desire to. Indeed, small scale farmers rely mainly on rain fed agriculture for which farming remains the predominant activity. It is however noted that rainfed agriculture is risky, vulnerable, diverse, and complex and underinvested (NRAA, 2012). Adaptive or coping capacity is therefore vital for the farming community such as the Bunyala Sub-County community to adjust to climate change. Barriers to coping such as the ones reported this study are therefore not new and reportedly vary across countries with lack of credit being considered as the main constraint.

The finding that lack of money/credit further corroborates the demographic results showing that most of these farmers are low income earners. This is indeed a key constraint to coping with rainfall variability, since as observed by Daberkow and McBride (2003) innovation which is important in coping comes with uncertainty and fixed transaction and information costs.

Low literacy level was also reported as a constraint to coping with rainfall variability. This is true considering, that low levels of literacy act as a hindrance to access to information, some of which could be important in mitigating risks associated with climate change. Indeed, technology is taking over most

agricultural functions and ability is vital for coping with changes.

The need for high literacy levels is consistent with findings by Rari Shanker *et al.,* (2013) that there exists a positive relation between education and adaptation to changing climate. It is prudent therefore to post that the illiteracy levels among small scale farmers in Bunyala sub-county limits their understanding of important innovations in modern farming.

The findings showing that lack of skills and knowledge constraint farmers in their adaptation and hence efforts do address this challenges should not be under estimated. Lack of knowledge and skills often obstructs small scale farmers from taking up coping measures they deem technical however relevant. This tends to breed the negative attitude identified in the present study since farmers look for scapegoats for not using particular strategies.

These findings support findings by Li *et al.,* (2013) that limited understanding of the importance of adaptation to livelihoods, coupled with limited knowledge of where and whom to contact for appropriate rainfall variability challenges.

The findings showing that female led households are more vulnerable are in tandem with findings by others (Asfair & Admassie 2004; Tenge *et al.;* 2004; Nhemachena & Hassan, 2007). These findings contend that gender of the household head influence uptake of new technologies thereby increasing or decreasing chances of coping that is besides culture and gender division of labour. Lack of money also features prominently among farmers and supports findings by Tittonell *et al.,* (2009) on farmers worry lack of money to buy food and lack of seed and input.

Some of the constraints are shown below.

Dry cotton plant as result of failed rains
Source: Researcher

: Water stressed tomato plants as a result of poor timing and decreased

Source: Researcher

Tomato growing using conventional method

Source: Researcher

Large herd of traditional cattle as opposed to dairy cows

Source: Researcher

Opportunities and Innovations Open to Small Scale Farmers in Bunyala Sub-County to enhance resilience to rainfall variability

To enhance coping strategies in the foreseeable future, farmers segmented opportunities and innovations available into three categories. Under financial innovations, farmers pointed out that they borrow from the bank to cope with rainfall variability; 32% of the farmers admitted to using this opportunity to overcome rainfall variability (see table 4.24). A significant proportion indicated that they borrow from family. Some farmers resorted to borrowing from money lenders (7.5%) and Shylocks (3.9%). Financial opportunities involve borrowing money mainly from banks but at times from money lenders and shylocks. This however poses challenges due to terms of repayment of borrowed money which often involve large interested rates. Borrowed money is used for subsistence and to a limited extent buying input. This shows that farmers are risk averse and may not be willing to invest further in poor conditions. Most financial institutions hardly give credit to farmers due to lack of collateral. The situation is made worse by farmer's perception of credit facilities and inability to repay especially considering the risk involved in investing in agricultural activities susceptible to rainfall variation leading to crop failure.

Most farmers tended to opt for social innovations to overcome stresses of rainfall variability; 70.7% indicated that they participate in saving groups; 60.4% pointed out that they participate in religious social groups/ circles. A substantial proportion (34.6%) indicated that they participate in funeral societies. Other farmers get engaged with reciprocal or exchange

work groups (22.4%) or festive work groups (16.8%).

They have set up investment groups which they, popularly refer to Mary go round aimed at raising the requisite money / credit for purchase of seeds and inputs. Others have formed religious social groups through which they hold prayer vigils hoping for upturn in opportunities. Reciprocal or exchange work groups is an innovative way of combining efforts to work in each other's farms as a group in order to cut on costs for farm labour. The local CBOs have been of much help to the community in improving their social economic status through an array of activities funded by the local NGOs. The NGOs support them with financial assistance, technical advice and supplying them with hybrid seed and livestock which are shared among the members. There is however need to promote capacity building and a bottom up approach to the management of the CBOs to make them more effective on their day to day activities.

Other opportunities or innovations that are open to farmers are agricultural innovations. To cope with rainfall variability, farmers have had to exploit existing opportunities/innovations. A majority of the farmers (54.6%) have opted to trade in vegetable and fruit seedlings. 46.3% reported to use of improved seed varieties. Other major innovations/opportunities reported include: varying fertilizer usage (30.6%); using improved chicken (Kienyeji) from Kari or acquired from the neighbouring Uganda (22.5%) among others.

Farmers have opted to trade in vegetable and fruit seedlings; use improved seeds resort to genetically modified paw paws, mango seedlings or rearing improved Kienyeji chicken (Croylers) and keeping dairy goats others include trading in tomatoes especially using the greenhouse technology. Lack of credit and technical knowhow is cited as impediments to full realization of the potential in these technologies. The findings particularly those reflecting on use of existing agricultural innovations such as genetic modifications are consistent with study findings which show that innovative practices such as integrated crop-livestock management are proven opportunities for mitigating future effects of climate change (FAO, 2010; World Bank, 2011; 2012). Agroforestry need to be promoted as there is very little of the same in the sub county the target species should include *Grevillea robusta, Thevetia peruviana, Jacaranda mimosifolia, Leuceana leococephala, Leuceana Lukina*. Demonstrations plots should be promoted to motivate the farmers and demonstrate the realities of what is said on paper.

Findings pointing to use of genetically modified papaws, mango trees, millet and cassava and tomatoes is a clear indication of acceptance of technology as an opportunity to manage coping strategies. This in fact reflects the World Bank report (2011) showing the need to embrace new technologies such as diversifying genetic traits of crops that resonate well with changing climatic patterns to help farmers edge against uncertainties in climates. Bunyala sub-county is one of areas that fall within the marginalized areas. It is therefore less suitable for arable farming as a result of land degradation (World Bank, 2012). It is therefore a welcome idea to see small scale farmers forming social groups to address rainfall variability. Through such groupings farmers can be able to maintain genetic diversity through use of different crop varieties. This will in essence insure them against future environmental change and help them meet social and economic needs.

Besides, insurance against future environmental changes, genetic diversity has potential to provide farmers with security against diseases (Zhn et al, 2000). Opportunities that focus on agricultural innovations are therefore crucial for continued farming in the region. Besides, the finding showing lack of access to electricity implies that while small scale farmers would like to innovate more in agriculture, they can't do so since most technologies depend on availability of electricity.

Opportunities and Innovations open to Small Scale Farmers to Cope Better

Opportunities/Innovations	% of farmers
Financial innovations	
Borrowed from family	14.7
Borrowed from money lender	7.5
Borrowed from shylocks	3.9
Borrowed from bank	32.0
Social Innovations	
Participation in funeral societies	34.6
Participation in savings groups	70.7
Participation in religious social groups/circles	60.4
Reciprocal or exchange work group	22.4
Festive work groups	16.8
Agricultural Innovations	
Variation of fertilizer	30.6
Use of improved seeds	46.3
Improved poultry (kienyeji from Kari/Uganda)	22.5
Improved bee hives	11.3
Breeding goats/dairy cows	14.6
Use of Banana seedlings	33.8
Use of vegetable and fruit seedlings	54.6

Results from the focused group discussions with farmer groups further revealed that among innovation/opportunities that farmers expect are: change of approach like use the bottoms up approach style of management that would involve farmers in decision making' tap into the potential provided by lake Victoria and enhance irrigation; and enhanced research by professionals

Focused Group Discussion Results on Opportunities/Innovations open to farmers

Question	Opportunity/innovation	Reason

What opportunities or innovations do you envisage to enhance coping with rainfall variability?	Bottoms up Management approach	• Involves community in decision making • Community suggests what works for them • Empowering women
	Irrigation	• Tap into surrounding waters of Lake Victoria and river Nzoia • Lay appropriate physical infrastructure to enable irrigation • Avoiding reliance on rain fed agriculture
	Research	• Professions conduct continuous research of possible solutions • Thorough soil analysis for innovating suitable crops • Diversification into improved livestock and seeds • Organize for farmers workshops and seminars • Use of demonstration plots

Information sharing through chiefs' barazas (local administration meetings), airing of programs with relevant information on agricultural production on local radio stations will go a long way in enhancing the resilience of the community to the effects of rainfall variations. Other avenues for information sharing include; FBO meetings (religious functions) which are open and accessible to the general public, meetings organized by the county Disaster Management Committees, Self Help Group meetings, NGO/CBO meetings, workshops and seminars, members of county assembly meetings. These channels are accessible to a small number of individuals expected to disseminate information to others.

Conclusions

Despite the efforts farmers are putting in place to cope with rainfall variability, several constraints stand in their way. Although farming technology is taking root, most farmers lack the knowledge and skills to engage these technologies. Besides, lack of credit facilities constraints farmers from accessing the necessary tools and equipment. Politicians exploit the situation by using it for political gains through goody goodies instead of seeking lasting solutions. There is however a ray of hope offered by the many opportunities and innovations farmers are undertaking.

Policy Implication

1. Small-scale farmers' should focus on information gathering enhance social networks to improve on their financial capability for example table banking. Institutions and local NGOs should work with the farmers by encouraging bottoms up approach to management of resources and incorporating
2. Local communities should be empowered through trainings programs on new technology for farming to improve small-scale agricultural productivity for example applying irrigation for food production to ensure food security and income generation can be encouraged.

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